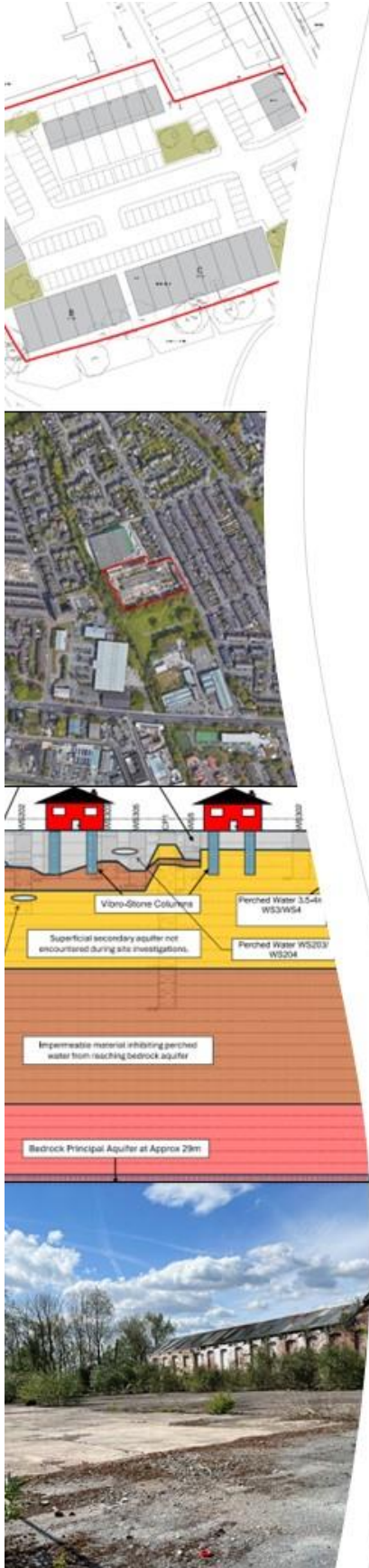




EARTH ENVIRONMENTAL
& GEOTECHNICAL

Site Investigation Summary Report

Louisa Street

Openshaw

October 2024

for

 Westchurch
Homes

Earth Environmental & Geotechnical Ltd
Houldsworth Mill Business Centre
Houldsworth Street
Stockport
SK5 6DA

Tel : 01619756088

Email
headoffice@earthenvironmental.co.uk

www.earthenvironmental.co.uk

**SITE INVESTIGATION
SUMMARY REPORT**

LOUISA STREET

OPENSHAW

Report Ref: A4755/22/SISR/V2

OCTOBER 2024

Prepared on Behalf of:

Westchurch Homes

By:

Earth Environmental & Geotechnical Ltd
Houldsworth Mill Business & Arts Centre
Houldsworth Street
Stockport
SK5 6DA

DISTRIBUTION:

1 electronic copy Westchurch Homes

SITE INVESTIGATION SUMMARY REPORT

LOUISA STREET, OPENSHAW

Report Reference: A4755/22/SISR/V2

Version B.0

Date: 31st October 2024

Prepared for: Westchurch Homes

Prepared by: Earth Environmental & Geotechnical Ltd
Houldsworth Mill Business & Arts Centre
Houldsworth Street
Stockport
SK5 6DA

Definition of Version Code:

- D. Applied during initial drafting of the report before it has been reviewed.
- C. Applied after the report has been reviewed but before it has been approved by the Project Manager.
- B. Applied after the Project Manager has approved the report ready for issue to the client.
- A. Applied to reports after external/internal review.

The version number starts at "0" and is raised by "1" at each re-type.

Written by:



Luke Glover
Principal GeoEnvironmental Consultant

Approved by:



Adam Czarnecki
Managing Director

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	PROPOSED DEVELOPMENT.....	1
1.3	SITE LOCATION & DESCRIPTION.....	1
1.4	TERMS OF REFERENCE.....	2
1.5	REPORT SCOPE	2
2.0	PREVIOUS INVESTIGATIONS.....	3
2.1	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, PHASE I GEOENVIRONMENTAL DESK STUDY (A4755/22/FDS), DATED JUNE 2022.....	3
2.2	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, GEO ENVIRONMENTAL SITE INVESTIGATION REPORT (A4755/22/SI), DATED JUNE 2022.....	3
2.3	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, INFILTRATION TESTING, DATED MAY 2023	9
2.4	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, SITE INVESTIGATION, DATED SEPTEMBER 2023	10
2.5	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, CHEMICAL TESTING LETTER REPORT, DATED OCTOBER 2023.....	11
2.6	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, TANK REMOVAL LETTER REPORT, DATED OCTOBER 2023	13
2.7	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, SOIL & GROUNDWATER ASSESSMENT, DATED APRIL 2024	15
2.8	EARTH ENVIRONMENTAL & GEOTECHNICAL LTD, ADDITIONAL ENVIRONMENTAL ASSESSMENT LETTER REPORT, DATED OCTOBER 2024	17
3.0	SUMMARY OF GROUND CONDITIONS ENCOUNTERED	22
3.1	SOIL PROFILE ENCOUNTERED.....	22
4.0	GROUNDWATER REGIME.....	25
4.1	TIER 2 CONTROLLED WATER RISK ASSESSMENT	25
5.0	CONCEPTUAL SITE MODEL	27

LIST OF FIGURES

Figure 1	Proposed Development Plan Showing Historical Features & SI Points
Figure 2	Aerial Photograph Showing Site Location
Figure 3	Exploratory Hole Location Plan – Original Investigation
Figure 4	Chemical Exceedance Location Plan – Original Investigation
Figure 5	Soakaway Testing Location Plan – May 2023
Figure 6	Additional Window Sampling Plan – September 2023
Figure 7	Delineation Sampling Plan – September 2023
Figure 8	Tank Removal Sampling Location Plan
Figure 9	Photograph of Tank Trial Pit, Post Tank Removal
Figure 10	Additional Borehole Location Plan – January 2024
Figure 11	SI Overlay Plan – September 2024
Figure 12	Conceptual Site Model

TABLES

Table 1	Summary of Ground Conditions Encountered – Original Investigation
Table 2	Summary of Soil Contamination – Original Investigation
Table 3	Summary of Asbestos Encountered – Original Investigation
Table 4	Waste Classification of Soils
Table 5	Summary of Ground Conditions Encountered – Infiltration Testing, May 2023
Table 6	Summary of Ground Conditions Encountered – September 2023
Table 7	Summary of Hot Spots from Original Site Investigation
Table 8	Summary of Ground Conditions Encountered – January 2024
Table 9	Summary of Ground Conditions Encountered
Table 10	Controlled Water Risk Assessment

APPENDICES

Appendix 1	SI Overlay Plan
------------	-----------------

1.0 INTRODUCTION

1.1 Background

The development of a Summary Report has been commissioned by Westchurch Homes (the Client), for a new residential development of 71no. affordable new homes at Louisa Street, Openshaw, Manchester. The purpose of this report is to pull together all stages of previous investigation work into a single report.

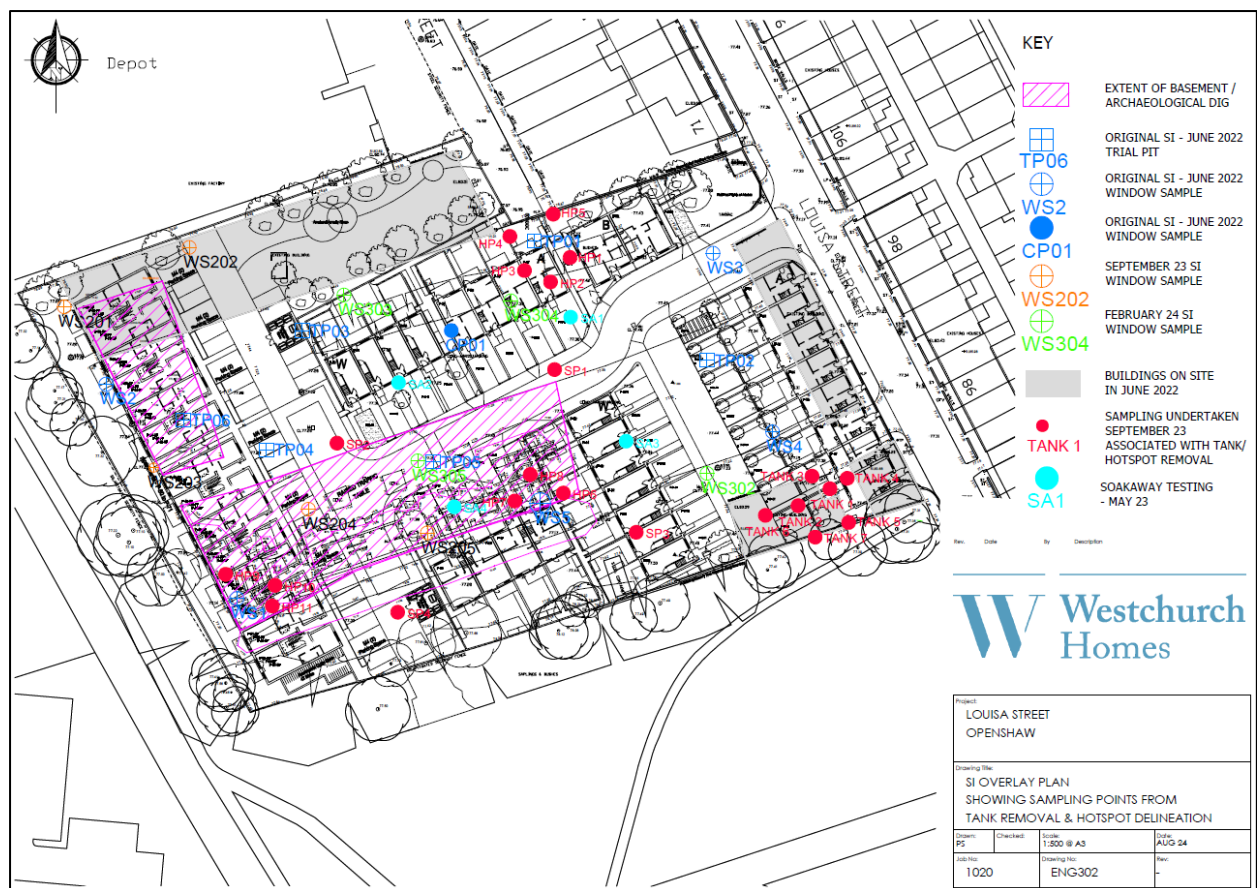
1.2 Proposed Development

The previously existing buildings on site have been demolished and 71no. new low rise (max 3 storey) affordable homes will be constructed on behalf of a Registered Provider (RP).

Site access will be retained via Louisa Street to the east of the site, via a new access road.

The proposed development layout details are shown in Figure 1 below.

Figure 1: Proposed Development Plan Showing Historical Features & SI Points



1.3 Site Location & Description

The site is located in Openshaw, Manchester, approximately 4.6km from Manchester City Centre.

The approximate National Grid Reference for the centre of the site is SJ 88592 97635 (X:388592, Y: 397635), with the closest postcode being M11 1AD.

The site is a near rectangular shaped parcel of land with current access via a gate off Louisa Street to the east of the site. The maximum dimensions of the proposed site are 82m north to south and 120m east to west. The site occupies an area of approximately 0.93 hectares.

The surrounding area comprises predominantly of residential properties. Industrial land uses are located immediately north of the site and to the south and southeast of the site. An open green space is located immediately south of the site along the boundary.

The site location is shown in the aerial photograph presented as Figure 2, below.

Figure 2: Aerial Photograph Showing Site Location



1.4 Terms of Reference

Earth Environmental and Geotechnical Ltd (EEG) have been commissioned by the Client to develop a report summarising the previous stages of site investigation work.

1.5 Report Scope

This report presents full factual records of the site work carried out, the ground conditions encountered in the exploratory holes, the in situ and laboratory test results. All information collected has been used to provide an interpretation of the ground conditions, with recommendations on geotechnical design and potential ground contamination risks for the proposed development.

2.0 PREVIOUS INVESTIGATIONS

2.1 Earth Environmental & Geotechnical Ltd, Phase I GeoEnvironmental Desk Study (A4755/22/FDS), dated June 2022.

Historically the site was vacant land until it was occupied by an Iron Foundry from the early 1900's. The area was dominated by heavy industry including, iron and steel works, mills, stream hammer works, electric motor works and railway sheds and sidings. The majority of the buildings on site were demolished in 2017/2018.

Potential on-site sources of contamination include possible contaminants (heavy metals, mineral acids, arsenic, and PCBs) in the Made Ground related to the historical iron foundry and electricity substation on site, subsequent works, and storage of materials on the site. Potential ground gas associated with the Made Ground on site and nearby infilled pits. Asbestos may be present on the site.

The risk from soil contamination to residential end users was considered to be **MODERATE**.

The risk to controlled waters was concluded to be **LOW** due to an absence of groundwater abstraction points and nearby surface waters.

The risk from ground gas to end users was considered to be **MODERATE**.

The risk from asbestos containing materials to end users was considered to be **MODERATE to LOW**.

The risk of groundwater flooding was **MODERATE**.

An intrusive investigation was recommended to establish geotechnical parameters for the design of foundations, floor slabs and pavement construction.

As part of the geotechnical investigation, it was recommended that samples are recovered for contamination testing, as well as installing ground gas/groundwater monitoring standpipes to assess ground gas risk, measure water levels and recover groundwater samples.

2.2 Earth Environmental & Geotechnical Ltd, Geo Environmental Site Investigation Report (A4755/22/SI), dated June 2022.

Site Investigation

The fieldwork was carried out by EEG on the 25th April 2022 and comprised:

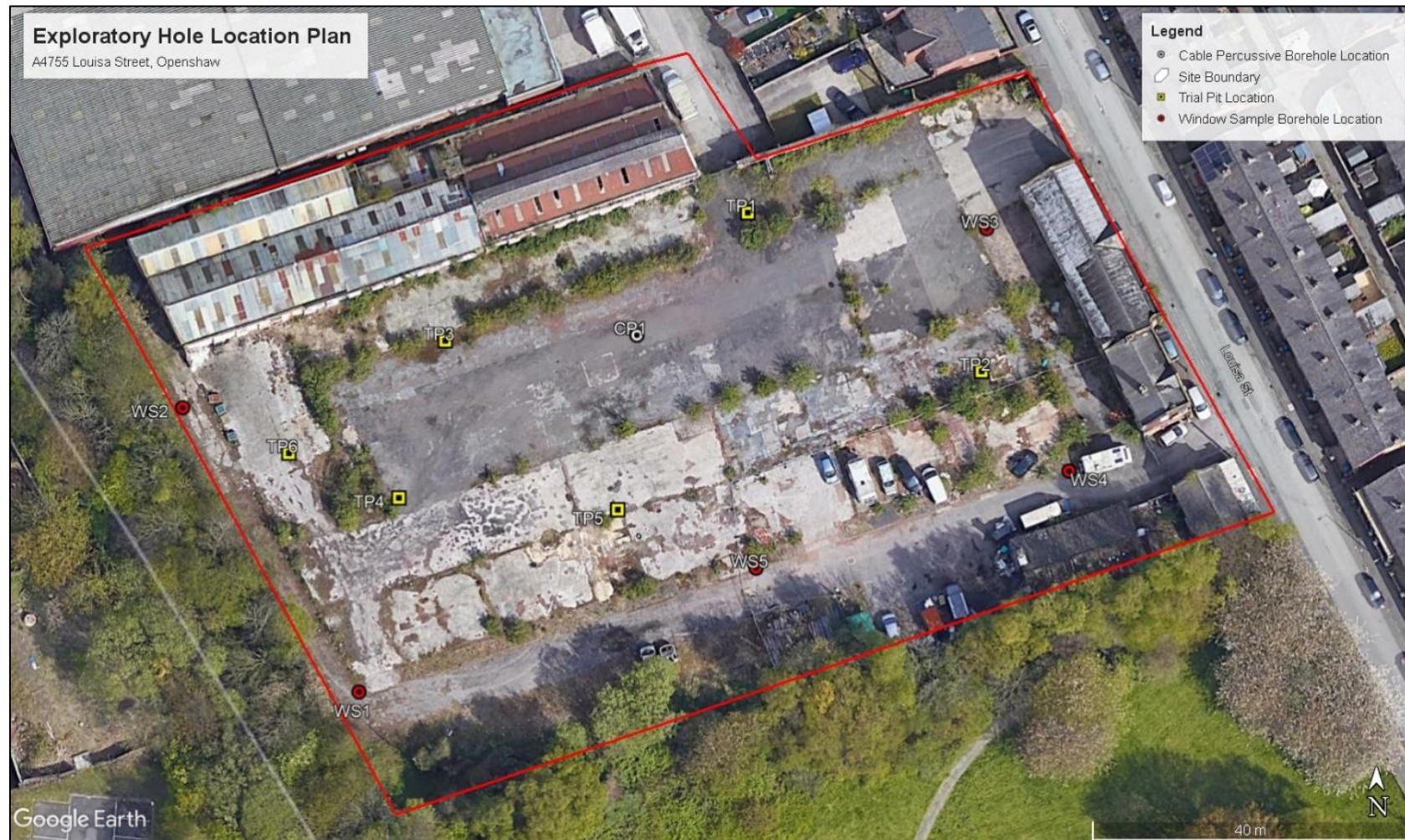
- Five window sample boreholes (designated WS1 – WS5 inclusive) were each sunk to a maximum depth of 5.00m below existing ground level.
- 50mm diameter standpipes were installed in all the window sample boreholes to a maximum depth of 5.00m below ground level.
- One 150mm diameter borehole (designated CP1) was sunk to a depth of 15.00m below existing ground level, using a cable percussion boring rig.
- Six trial pits (designated TP1 to TP6 inclusive) were excavated by use of a JCB 3CX to a maximum depth of 3.50m bgl. Trial pits were backfilled immediately on completion of sampling and testing.

Groundwater observations were noted where possible.

A plan showing the location of the exploratory holes is included as Figure 3 overleaf.

Samples of the encountered soils were recovered for chemical and geotechnical testing

Figure 3: Exploratory Hole Location Plan – Original Investigation



Chemical analyses were carried out on ten soil samples and were submitted for the following suite of determinants:

Asbestos Screen, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Phenol, Sulphate (SO₄), Sulphide, pH, Soil Organic Matter, Extractable Petroleum Hydrocarbons (EPH), Speciated Total Petroleum Hydrocarbon (TPH) and Speciated Polyaromatic Hydrocarbons (PAH).

Waste Acceptance Criteria Testing (WAC) was also carried out on two soil samples.

Chemical analyses were also carried out on two groundwater samples and were submitted for the following suite of determinants:

Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Phenol, Sulphate (SO₄), Sulphide, pH, Total Organic Carbon (TOC), Extractable Petroleum Hydrocarbons (EPH), Speciated Petroleum Hydrocarbon (TPH) and Speciated Polyaromatic Hydrocarbons (PAH).

Ground Conditions Encountered

The sequence of strata encountered beneath the site was as follows:

Table 1: Summary of Ground Conditions Encountered – Original Investigation

Hole	Depth to Stratum (m bgl)				GROUNDWATER (m bgl)
	MADE GROUND		SUPERFICIAL DEPOSITS		
	Granular	Cohesive	SAND	CLAY	
CP1	GL – 1.10	-	1.10 – 2.30 2.80 – 11.50	2.30 – 2.80 11.50 – 15.00+	-
WS1	GL – 1.60 2.00 – 2.90	1.60 – 2.00	-	2.90 – 4.00+	-
WS2	GL – 1.20 1.50 – 2.50+	1.20 – 1.50	-	-	-
WS3	GL – 1.20	1.20 – 1.50	1.50 – 5.00+	-	4.00
WS4	GL – 0.55	0.55 – 1.60	1.60 – 4.50+	-	3.50
WS5	GL – 1.40 1.80 – 2.20	1.40 – 1.80 2.20 – 2.50	3.00 – 5.00+	2.50 – 3.00	-
TP1	GL – 0.20	0.20 – 0.60	0.60 – 2.60	-	-
TP2	GL – 0.50	0.50 – 1.20	1.20 – 2.80	-	-
TP3	GL – 2.50	-	-	2.50 – 3.20	-
TP4	GL – 2.70	-	-	2.70 – 3.50	-
TP5	GL – 2.40	2.40 – 2.90	-	2.90 – 3.30	-
TP6	GL – 0.40+	-	-	-	-

Depths in red indicate termination within the Made Ground.

Depths in red indicate termination within the Made Ground.

It should also be noted that a basement was encountered while excavating TP6. This has since been infilled and treated.

Soil Contamination Assessment

Eleven contaminant concentrations were found in exceedance of the screening criteria relevant to a Residential End Use.

The samples with identified contaminant exceedances include WS1 at 0.30m, WS5 at 0.65m, and TP1 at 0.40m. The exceedances are included in Tables 2 & 3 and Figure 4 below.

Table 2: Summary of Soil Contamination – Original Investigation

Location	Contaminants
WS1 (0.30m)	Naphthalene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene
WS5 (0.65m)	Benzo(b)fluoranthene, Dibenz(a,h)anthracene
TP1 (0.40m)	Petroleum Hydrocarbon (Aromatic EC >16-21), Benzo(a)anthracene, Chrysene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene

Table 3: Summary of Asbestos Encountered – Original Investigation

Location	Depth (m)	Sample Matrix	Asbestos Type	Asbestos Quantification
WS1	0.30	Loose Fibres	Chrysotile	<0.001%
WS2	0.50	Loose Fibres	Chrysotile	0.001%

Figure 4: Chemical Exceedance Location Plan – Original Investigation



Follow up testing on the 8th September 2023 found these hotspots to be free of the previously identified contamination due to removal of the material during the archaeological excavations.

Soil Disposal

An assessment of the disposal characteristics of the soil in accordance with Environment Agency guidance WM3.1, edition of June 2018, "Guidance on the classification and assessment of waste" has been carried out on soils recovered from the site, using HazWasteOnline. The results are summarised in the table below.

Table 4: Waste Classification of Soils

Location	Depth (m bgl)	WM3.1 Classification	Comments
WS1	0.30	Non-Hazardous	-
WS2	0.50	Non-Hazardous	-
WS3	1.00	Non-Hazardous	-
WS4	1.20	Non-Hazardous	-
WS5	0.65	Non-Hazardous	-
TP1	0.40	Hazardous	Elevated TPH
TP2	0.25	Non-Hazardous	-
TP3	0.90	Non-Hazardous	-
TP4	0.70	Non-Hazardous	-
TP5	0.45	Non-Hazardous	-

Groundwater Contamination Assessment

Groundwater samples could only be recovered within WS1 and WS4, all other wells were dry

In the absence of specific UK guidelines regarding groundwater quality in the UK, chemical results obtained by EEG have been compared with the following statutory and non-statutory standards:

- Environmental Quality Standards (EQS); and
- UK Drinking Water standards ⁽²⁰⁰⁰⁾.

Many of the measured EQS values lie just above the method detection limit for parameters and as such, are extremely conservative. In the absence of EQS standards, Drinking Water Standards have been used for comparison of results. Again, these standards are highly conservative, especially in this site context.

There were no contaminant exceedances in the groundwater samples taken on the 16th May 2022 and therefore the risk to controlled waters was considered to be very low.

Ground Gas Contamination Assessment

The site is not located within a Radon Affected Area as defined by the Health Protection Agency, and therefore radon protection measures were not considered necessary.

A total of six gas monitoring visits were completed by Earth Environmental & Geotechnical Ltd. The results recorded methane (CH₄) levels of 0.0% (v/v) and carbon dioxide (CO₂) levels of 0.1% to 6.6% v/v. Oxygen concentrations of between 12.4% to 21.3% v/v were also recorded.

Gas flow rates were recorded between -0.2l/hr to 0.1l/hr and a maximum flow rate of 0.1l/hr was adopted for calculations. Atmospheric pressure was recorded to be between 993mb and 1016mb.

A GSV for the site has been obtained by multiplying the maximum concentration of gas by the steady flow rate of 0.1l/h adopted for assessment purposes. The results suggested the site could be given a Characteristic Situation 1, i.e., 'very low risk'.

Remedial Recommendations

Soil Contamination

Based on the results of the chemical testing, there was deemed to be a moderate potential risk to residential end users.

A follow-up investigation was recommended to delineate the contamination present.

The development of a Remediation Strategy was also recommended, detailing the remedial measures to be implemented to mitigate the risk and any following validation work.

Groundwater Contamination

Chemical testing was carried out on two groundwater samples and no exceedances in contaminants were observed, suggesting that potentially leached made ground has not impacted groundwater beneath the site.

The risk to controlled waters from contamination was therefore considered to be low.

Ground Gas Contamination

The report concluded that the monitoring dataset indicated the site would fall in Characteristic Situation 1 (CS1) ('very low' gas risk). Therefore, ground gas protection measures were not considered necessary for the proposed development.

2.3 Earth Environmental & Geotechnical Ltd, Infiltration Testing, dated May 2023

Over the course of one day (5th May 2023), four locations (SA1 to SA4) were excavated by means of a tracked hydraulic excavator. All of these pits were designated for soakaway testing. Due to the slow infiltration rate of the pits, only one fill with water was carried out at each location. This was carried out by filling the excavation rapidly with water from a towed water bowser. A plan of the testing is provided as Figure 5 overleaf.

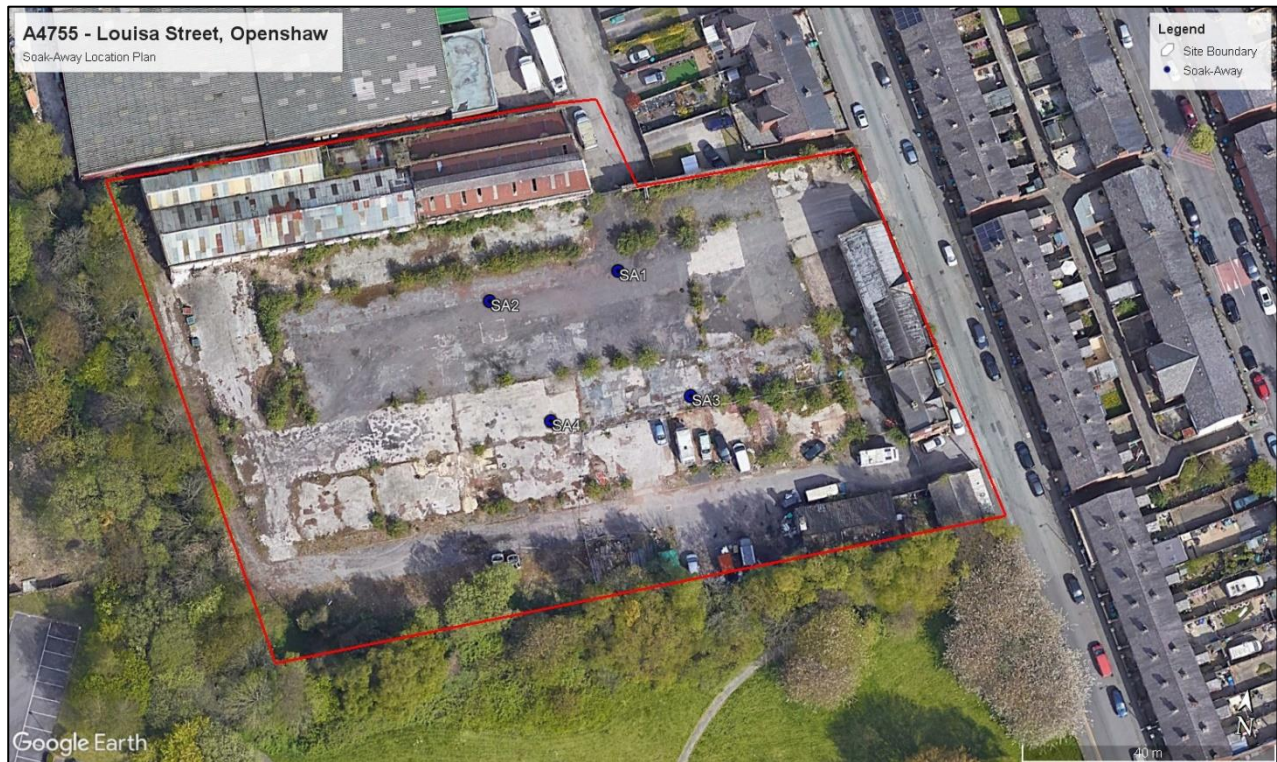
The infiltration rate of each location could not be calculated due to the slow rate at which the water drained away.

This highlights that the sand horizon has a low permeability.

Table 5: Summary of Ground Conditions Encountered – Infiltration Testing, May 2023

Hole	Depth to Stratum (m bgl)				GROUNDWATER (m bgl)
	MADE GROUND		SUPERFICIAL DEPOSITS		
	Granular	Cohesive	SAND	CLAY	
SA1	GL – 0.60	-	0.60 – 2.20	-	-
SA2	GL – 0.50	-	2.80 – 3.00	0.50 – 2.80	-
SA3	GL – 0.80	-	0.80 – 2.45	-	-
SA4	GL – 1.80	-	1.80 – 2.50	-	-
Depths in red indicate termination within the Made Ground.					

Figure 5: Soakaway Testing Location Plan – May 2023



2.4 Earth Environmental & Geotechnical Ltd, Site Investigation, dated September 2023

Five boreholes (WS201 to WS205) were drilled on the 14th September 2023 in order to provide supplementary information to assist with the design of a ground improvement scheme. A summary of the ground conditions encountered is presented in Table 6 along with a plan of the borehole locations in Figure 6 overleaf.

Chemical testing was not conducted on soil or groundwater samples.

The testing proved a complex sequence of sand and clay, with some protection of the granular horizon by clay deposits.

Table 6: Summary of Ground Conditions Encountered – September 2023

Hole	Depth to Stratum (m bgl)				GROUNDWATER (m bgl)
	MADE GROUND		SUPERFICIAL DEPOSITS		
	Granular	Cohesive	SAND	CLAY	
WS201	GL – 2.50 2.90 – 3.30	2.50 – 2.90	-	3.30 – 4.00	-
WS202	GL – 1.80 2.40 – 2.80	1.80 – 2.40 2.80 – 3.00	5.00 – 7.00	3.00 – 5.00	5.60 (Strike)
WS203	GL – 1.50 2.00 – 2.70	1.50 – 2.00	3.20 – 3.90 4.60 – 6.00	2.70 – 3.20 3.90 – 4.60	3.10 (Strike)
WS204	GL – 3.70	-	-	3.70 – 4.00	2.00 (Strike)
WS205	GL – 1.00	-	1.50 – 1.80 4.30 – 7.00	1.00 – 1.50 1.80 – 4.30	2.00 (Strike)
Depths in red indicate termination within the Made Ground.					

Figure 6: Additional Window Sampling Plan – September 2023



2.5 Earth Environmental & Geotechnical Ltd, Chemical Testing Letter Report, dated October 2023

EEG were requested to further delineate hotspots of shallow contamination identified within the June 2022 site investigation. An archaeological dig had been undertaken which extended across hotspot areas and therefore the majority of hotspot areas had already been excavated and removed.

Table 7 overleaf details the hotspots which are all shallow and in Made Ground.

Further sampling was conducted across the site with the locations shown in Figure 7. HP1 to HP11 were conducted for the purposes of delineating the previously identified hotspots. Four samples (SP1 to SP4) were also taken from stockpiles of material surrounding the archaeological excavation.

It should be noted that the samples from surrounding WS1 and WS5 (HP6 to HP11) were taken from inside the archaeological excavation, as this encompassed the area where these hotspots were previously located. Therefore, the samples were taken at depths between 1.05m and 1.55m below the original ground level.

A total of 15no. samples were selected for chemical testing for a wide range of potential contaminants of concern including asbestos, metals, speciated hydrocarbons and speciated polycyclic aromatic hydrocarbons.

Delineation samples ranged in depth from 0.40m to 1.55m below original ground level and all were within made ground.

All concentrations from the delineation samples were proved to be below residential end use (with plant uptake) criteria. A singular minor exceedance of arsenic was identified in one of the samples located in the stockpiled material.

The above work further reinforces the conclusion that the made ground is not contaminated and the source of contamination from the perspective of a groundwater risk assessment is low.

Table 7: Summary of Hot Spots from Original Site Investigation

Location	Land Use	Depth (m)	Soil Description	Contaminant
WS1	House Plot	0.30	Made Ground	Chrysotile asbestos fibres <0.001% Naphthalene Benzo(b) fluoranthene Dibenzo (a, h) anthracene
WS2	House Plot	0.50	Made Ground	Chrysotile asbestos fibres 0.001%
WS5	House Plot	0.65	Made Ground	Benzo(b) fluoranthene Dibenzo (a, h) anthracene
TP1	Landscaped Area	0.40	Made Ground	TPH Aromatic 16-21 Benzo(a)anthracene Chrysene Benzo(a)pyrene Benzo (b) fluoranthene Dibenzo (a, h) anthracene

Figure 7: Delineation Sampling Plan – September 2023



2.6 Earth Environmental & Geotechnical Ltd, Tank Removal Letter Report, dated October 2023

A site visit was conducted on the 25th September to supervise the removal of soils impacted by the underground tank identified by the client.

Upon arrival, the underground tank had been degassed and removed (Friday 22nd September 2023) from the site.

A concrete foundation slab, that the steel tank was originally placed on, was uncovered during the removal of the contaminated material. This slab was removed along with the impacted soils. A strong hydrocarbon odour was identified during the removal of the slab, along with the observation of an oily sheen. All remaining visually, and olfactory contaminated soils were excavated and stockpiled.

A total of five soil samples were retrieved from the sidewalls and base of the excavation following the removal of the visually and olfactory impacted material. Additionally, two samples were obtained from the contaminated stockpiled material removed from the trial pit, to assess the material for off-site disposal.

A photo-ionisation detector (with 10.6eV lamp) was used to measure the concentration of volatile organic compounds in the headspace of soil samples. All measured concentrations were below 5ppm.

Figure 8: Tank Removal Sampling Location Plan



Figure 9: Photograph of Tank Trial Pit, Post Tank Removal



Chemical analyses were carried out on five soil samples from the walls and base of the tank and were submitted for exclusively *Speciated Petroleum Hydrocarbons*

Chemical analyses were carried out on two soil samples from the contaminated tank stockpile and were submitted for the following suite of determinants:

Asbestos Screen, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Phenol, Sulphate (SO₄), Sulphide, pH, Soil Organic Matter, Speciated Polyaromatic Hydrocarbons (PAH) and Speciated Petroleum Hydrocarbons.

Based on the chemical testing results, the sample collected from the southern wall of the tank trial pit (Tank 5) contained a marginally elevated concentration of benzene when compared to the screening criteria relevant to a residential end use with home grown produce. The remaining samples tested from the walls and base of the tank pit contained no concentrations of contaminants in exceedance of the relevant screening criteria. The exceedance was considered to be insignificant, and no further action is necessary.

The soil samples collected from the material to be removed off-site (Tank 6 & 7) were classified as Non-Hazardous for the purpose of off-site disposal, based on the WM3.1 classification. Further WAC testing showed the material to be classified as Inert Waste.

2.7 Earth Environmental & Geotechnical Ltd, Soil & Groundwater Assessment, dated April 2024

Site Investigation

The letter report consisted of a summary of the ground conditions, additional drilling, leachate chemical testing, refined conceptual site model and further assessment to controlled waters.

On the 16th January 2024, four additional window sample boreholes (WS302 to WS305) were carried out to a maximum depth of 4.70m below ground level, for the recovery of chemical samples and the installation of groundwater monitoring wells. The ground conditions encountered during the investigation are summarised in Table 8 with the borehole locations displayed in Figure 10.

The window sampling boreholes could not reach their planned depth due to the density of a granular horizon.

Two visits were undertaken on the 23rd January and 1st February 2024. However, insufficient water was present, in all boreholes, to allow for groundwater sampling.

Leachate chemical analysis has been carried out on five leachate samples, from a depth range of ground level to 1m below ground level, and submitted for the following suite of determinants:

Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Phenol, Sulphate (SO₄), Sulphide, pH, Total Organic Carbon (TOC), Speciated Polycyclic Aromatic Hydrocarbons (PAH) and Speciated Total Petroleum Hydrocarbons.

The GL to 1m depth range of sampling was adopted to also assess the potential effects of volatile compounds on human health risk. It was noted that the made ground was consistent in

composition. Therefore, testing from a deeper depth range was deemed unlikely to reveal different leachability characteristics.

Groundwater Contamination Assessment

In the absence of specific UK guidelines regarding groundwater quality in the UK, soil leachate chemical results obtained by EEG were compared with the following statutory and non-statutory standards:

- Environmental Quality Standards (EQS); and
- UK Drinking Water standards ⁽²⁰⁰⁰⁾.

Many of the EQS values lie just above the method detection limit for parameters and as such, are extremely conservative.

In the absence of EQS standards, Drinking Water Standards have been used for comparison of results. Again, these standards are highly conservative, especially in this site context.

After comparison of the original investigation water samples and the leachate testing from this additional sampling, only one exceedance was identified. This was for an elevated pH value from the additional leachate testing at WS304 (0.70m).

This elevated pH value was thought to have been caused by the presence of concrete in the soil sample prior to leachate sample preparation. This is therefore considered not to be a risk to groundwater quality.

Given the environmental setting of the site, and lack of significant exceedances, the risk to groundwater from contamination was considered to be low.

Table 8: Summary of Ground Conditions Encountered – January 2024

Location	Made Ground Thickness (m)	BASE SAND (m bgl)	BASE CLAY (m bgl)	Installation Response Zone	Water Strike	Water Depth 21/1/24	Water Depth 1/2/24
WS302	1.50	4.00+	-	1.00-4.00	DRY	DRY	DRY
WS303	2.50	-	4.00+	1.00-4.00	DRY	DRY	DRY
WS304	1.60	4.00+	-	1.00-4.00	DRY	DRY	DRY
WS305	3.40	-	4.70+	1.00-4.70	DRY	DRY	DRY

Figure 10: Additional Borehole Location Plan – January 2024



2.8 Earth Environmental & Geotechnical Ltd, Additional Environmental Assessment Letter Report, dated October 2024

Site Investigation

The letter report consisted of a summary of the ground conditions, additional drilling, soil and groundwater chemical testing, refined conceptual site model and further assessment to controlled waters.

Between the 4th and 10th September 2024, three additional cable percussive boreholes (CP401, CP403 and CP404) to a maximum depth of 10.50m below ground level, as well as five window sample borehole carried out to a maximum depth of 4.40m below ground level, for the recovery of chemical samples and the installation of groundwater monitoring wells. The borehole locations are displayed in an overlay plan (Figure 10) of all boreholes carried out on site.

The window sampling boreholes were proposed to be conducted to a provisional depth of 7.00m below the existing ground level. However, the underlying superficial sand deposits were found to be of too high density for the window sampling rig to penetrate. This meant that these boreholes had to be terminated early with only a maximum depth of 4.40m bgl achieved before refusal on the dense sand material.

Groundwater was only encountered in CP403 at 7.00m bgl and CP404 at 6.20m bgl during the fieldwork. It should be noted that groundwater was not encountered in CP401 or CP01 (the cable percussive borehole from the original investigation) despite the entirety of the superficial sand material being sampled. The groundwater level is therefore likely to be of a variable depth beneath the site.

The installed window sample boreholes were recorded to be dry upon monitoring. This is attributed to the boreholes not reaching the groundwater level, identified in CP403 and CP404 to be between 6.20m and 7.00m bgl, due to refusal on the dense sand material.

Soil Contamination Assessment

Chemical analyses were carried out on 32no. soil samples, from Made Ground as well as natural superficial deposits, and were submitted for the following suite of determinants:

Asbestos Screen, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Phenol, Sulphate (SO₄), Sulphide, pH, Soil Organic Matter, Speciated Polyaromatic Hydrocarbons (PAH) and Speciated Petroleum Hydrocarbons.

After further analysis of the contamination present within the samples taken during this investigation, material from CP403 (0.10m), WS412 (2.00m) and WS412 (3.50m) contained elevations of contaminants deemed potentially harmful to future site users with regard to a residential end use (with homegrown produce).

Using benzo(a)pyrene as a surrogate marker for carcinogenic PAHs has shown that the contaminants found in the samples from CP401 (0.20m & 1.00m) are unlikely to pose a carcinogenic risk to residential end users.

It should also be noted that the contamination located within CP403 and WS412 will be located underneath hardstanding in the proposed development, with CP403 being located under an asphalt area related to the adjacent substation and WS412 being located under a road. The contamination within WS412 was only detected within the Made Ground at depths of between 2.00m and 3.50m below ground level with the above samples at 0.10m and 1.20m being clear from any elevated concentrations of contaminants.

Due to the further analysis of the chemical data and the location/depth of the contamination in relation to the proposed development, as well as previous chemical testing, the risk to future site users with regards to the proposed residential end use is considered to be low.

Due to the inferred origin of the contamination, it is unlikely to be mobile enough to have a significant effect on underlying groundwater. The risk of soil contamination to controlled waters is therefore considered to be low.

Controlled Water Risk Assessment

Chemical analysis has been carried out on 6no. groundwater samples and submitted for the following suite of determinants:

Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Phenol, Sulphate (SO₄), Sulphide, pH, Total Organic

Carbon (TOC), Speciated Polycyclic Aromatic Hydrocarbons (PAH) and Speciated Total Petroleum Hydrocarbons.

In the absence of specific UK guidelines regarding groundwater quality in the UK, chemical results obtained by EEG have been compared with the following statutory and non-statutory standards:

- UK Drinking Water standards (DWQ) ⁽²⁰⁰⁰⁾.

Drinking Water Standards have been used for comparison of results. Again, these standards are highly conservative, especially in this site context.

A total of six groundwater samples were retrieved across two visits from the monitoring wells installed across the site.

In general, the laboratory analyses encountered low concentrations of contaminants which were below the Drinking Water Standards. However, exceedances of 2no. contaminants were encountered within the samples, as summarised below.

The only exceedances of DWQ were for lead and fluoranthene. In the case of fluoranthene it was a slight exceedance (trivial).

The lead exceedance is probably not due to any contamination source but merely a background concentration in a sand aquifer. It should be noted that the measured concentration of lead in made ground varies from <3 to 462mg/kg, i.e. very low concentrations.

In superficial deposits the lead concentration has varied from <3mg/kg to 12mg/kg.

Baseline ranges in all UK aquifers range from 1ug/litre to 10ug/litre (The Natural baseline quality of groundwater in England and Wales. BGS Research reports RR/07/06 and Technical Report NC/99/74/24,2007).

Given the DWQ guidelines are particularly stringent and based on the type of proposed development and end use, the identified exceedances within the groundwater samples does not pose a risk to controlled waters.

As there are no surface water features identified within 250m of the site, the potential for sub-surface migration of the contaminants into a local water course is considered to be very low.

A thick layer of impermeable clay material is present between the superficial aquifer and the underlying principal bedrock aquifer.

Therefore, the risk to the underlying principal aquifer from any contamination is considered to be low.

It should also be noted that the principal aquifer is recorded to be part of the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers, which were given a poor chemical and overall rating in 2019.

There is little in the way of a significant contamination source within on-site soils that would be a risk to controlled waters. The inferred origin of the contamination identified during this investigation is unlikely to be mobile enough to impact underlying groundwater.

While a potential downwards migration pathway may be present between the Made Ground and the superficial aquifer, in areas of the site where shallow clay is not present, there is little evidence that this pathway is influencing controlled waters. The large deeper clay horizon will block all downwards migration to the principal bedrock aquifer and as such no credible pollutant pathway exists that could impact this.

As stated previously, an absence of nearby surface waters or groundwater abstraction are present. The only credible receiver of pollutants from potential on-site contamination are the underlying aquifers. Based on the ground conditions and environmental testing, there is considered to be no potential impact to controlled waters beneath the site and the site is suitable for use with no remedial measures necessary.

3.0 SUMMARY OF GROUND CONDITIONS ENCOUNTERED

3.1 Soil Profile Encountered

BGS digital mapping shows the site is underlain by superficial deposits of Devensian Till, comprising Diamicton.

The solid geology beneath the site is recorded as the Chester Pebble Beds Formation, comprising sandstone (Early Triassic Age). The eastern part of the site is also recorded to be underlain by artificial deposits of infilled ground.

The sequence of strata encountered beneath the site was as follows:

- **Made Ground –** Variable Made Ground was encountered in all of the exploratory holes to a maximum depth of 2.90m bgl, comprising:
 - Asphalt Hardstanding
 - Concrete (with rebar in TP6 only)
 - Sandy GRAVEL containing gravel of sandstone, ash, clinker, slag, metal and redbrick with cobbles of red brick, metal, and timber (CP1 and WS1)
 - Gravelly SAND containing gravel of sandstone, plastic, concrete, and red brick with cobbles of redbrick
 - Gravelly CLAY containing gravel of ash and clinker
 - Sandy gravelly CLAY containing gravel of red brick and sandstone
 - SAND
 - Clayey sandy GRAVEL containing gravel of sandstone and red brick with cobbles of red brick and timber
 - Sandy CLAY
 - Sandy gravelly COBBLES containing gravel of red brick and yellow brick with cobbles of red brick and yellow brick

- **Superficial Deposits –**

Sand was encountered in exploratory holes CP1, WS3, WS4, WS5, TP1 and TP2 to a maximum depth of 11.50m bgl, comprising:

- Gravelly SAND containing gravel of sandstone
- Silty gravelly SAND containing gravel of sandstone and carbonaceous fragments
- Clayey gravelly SAND containing gravel of sandstone with cobbles of sandstone

Clay was encountered in exploratory holes CP1, WS1, WS5, TP3, TP4 and TP5 to a maximum depth of 15.00m bgl, comprising:

- Sandy CLAY
- CLAY

The depths of the various materials encountered in the exploratory holes are summarised in Table 9, overleaf.

The locations of all the excavations carried out at this site can be seen on a combined plan, included as Appendix 1.

Table 9: Summary of Ground Conditions Encountered

Location	Made Ground Thickness (m)	BASE SAND (m bgl)	BASE CLAY (m bgl)	Installation Response Zone	Water Strike	Water Depth 30/5/22	Water Depth 23/1/24	Water Depth 1/2/24	Water Depth 20/9/24	Water Depth 30/9/24
WS1 (April 2022)	2.9	-	4.0+	1.0-4.0	2.5	2.68 (MG)	-	-	-	-
WS2 (April 2022)	2.5+	-	-	0.5-2.5		DRY	-	-	-	-
WS3 (April 2022)	1.5	5.0+	-	1.0-5.0	4.0	3.57 (SAND)	-	-	-	-
WS4 (April 2022)	1.6	4.5+	-	1.0-4.0	3.5	3.02 (SAND)	-	-	-	-
WS5 (April 2022)	2.5	5.0+	3.0	1.0-5.0	DRY	DRY	-	-	-	-
CP1 (April 2022)	1.1	11.5	15.0+	No Well	DRY	-	-	-	-	-
TP1 (April 2022)	0.6	2.6+	-	-	DRY	-	-	-	-	-
TP2 (April 2022)	1.2	2.8+	-	-	DRY	-	-	-	-	-
TP3 (April 2022)	2.5	-	3.2+	-	DRY	-	-	-	-	-
TP4 (April 2022)	2.7	-	3.5+	-	DRY	-	-	-	-	-
TP5 (April 2022)	2.9	-	3.3+	-	DRY	-	-	-	-	-
TP6 (April 2022)	0.4+ (Basement)	-	-	-	DRY	-	-	-	-	-
WS201 (Sept 2023)	3.3	-	4.0+	-	-	-	-	-	-	-
WS202 (Sept 2023)	3.0	7.0+	5.0	-	5.6	-	-	-	-	-
WS203 (Sept 2023)	2.7	6.0+	3.2, 3.9-4.6	-	3.2	-	-	-	-	-
WS204 (Sept 2023)	3.7	-	4.0+	-	2.0	-	-	-	-	-
WS205 (Sept 2023)	1.0	7.0+	4.3	-	2.0	-	-	-	-	-

Location	Made Ground Thickness (m)	BASE SAND (m bgl)	BASE CLAY (m bgl)	Installation Response Zone	Water Strike	Water Depth 30/5/22	Water Depth 23/1/24	Water Depth 1/2/24	Water Depth 20/9/24	Water Depth 30/9/24
WS302 (Jan 2024)	1.5	4.0+	-	1.0-4.0	DRY	-	DRY	DRY	-	-
WS303 (Jan 2024)	2.5	-	4.0+	1.0-4.0	DRY	-	DRY	DRY	-	-
WS304 (Jan 2024)	1.6	4.0+	-	1.0-4.0	DRY	-	DRY	DRY	-	-
WS305 (Jan 2024)	3.4	-	4.7+	1.0-4.7	DRY	-	DRY	DRY	-	-
CP401 (Sep 2024)	2.5	8.5	10.5+	5.0-8.5	DRY	-	-	-	3.42	3.20
CP403 (Sep 2024)	2.5	8.3	9.5+	5.0-8.5	7.0	-	-	-	4.65	4.37
CP404 (Sep 2024)	2.4	8.6	10.5+	5.0-8.5	6.2	-	-	-	4.72	4.75
WS410 (Sep 2024)	2.1	3.0+	-	1.0-3.0	-	-	-	-	-	-
WS411 (Sep 2024)	2.6	4.4+	-	2.6-4.4	-	-	-	-	-	-
WS412 (Sep 2024)	3.6	-	-	1.0-3.5	-	-	-	-	-	-
WS413 (Sep 2024)	2.5	-	3.5	1.0-3.5	-	-	-	-	-	-
Minimum	0.60	-	-	-	2.50	2.69	-	-	3.42	3.20
Average	2.22	-	-	-	3.33	3.10	-	-	4.26	4.11
Maximum	3.70	-	-	-	4.00	3.58	-	-	4.72	4.75

4.0 GROUNDWATER REGIME

The Conceptual Site Model (Figure 12) indicates that the site is underlain by a variable thickness of made ground underlain by clay and sand.

Perched water has been found, supported by impermeable clay at WS1, WS203, WS203 and WS204.

Groundwater strikes were encountered in WS202 (5.60m), CP403 (7.00m) and CP404 (6.20m) within a sand horizon below a sequence of clay 3m to 5m.

WS3 and WS4 encountered water at a depth of 3.00m and 3.57m within the sand horizon which are considered to be perched and not representative of a local water table.

Chemical testing of water samples in WS1 (perched water), WS4 (perched water), CP401 (groundwater), CP403 (groundwater) and CP404 (groundwater) has revealed an absence of any contaminants of concern.

Water wells were installed in WS302-WS305 to a depth of 4.7m. Subsequent monitoring on the 23rd January 2024 and 1st February 2024, revealed that all boreholes were dry, despite the presence of sand in WS302 and WS304.

These wells further reinforce that the water in WS3 and WS4 are perched and not representative of a local groundwater table.

The overall groundwater regime is therefore complex and variable below the site. However, the groundwater table was encountered above the superficial clay deposits at depth between 5.60m to 7.00m below ground level.

4.1 Tier 2 Controlled Water Risk Assessment

Table 10: Controlled Water Risk Assessment

RISK PROFILE	DISCUSSION	SENSITIVITY RATING
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	None	Low
Distance to the Closest Groundwater Abstraction Point	758m (not active) No potable abstraction points within 2km	Low
Aquifer Classification in Superficial Drift Deposits	Superficial Undifferentiated (not Secondary A or Secondary B)	Medium
Aquifer Classification in Bedrock	Principal	Low
Water Framework Directive Groundwater Classification	Poor (2019)	Low
Groundwater Vulnerability		Low
Is the Site Located Within 50m of a Surface Watercourse?	None within 250m	Low

The CSM developed within the context of the site setting has identified the following viable pollutant pathways:

- Vertical migration to the Primary / Secondary Aquifer.

However, no significant sources of contamination within soil or groundwater have been identified as currently present on site.

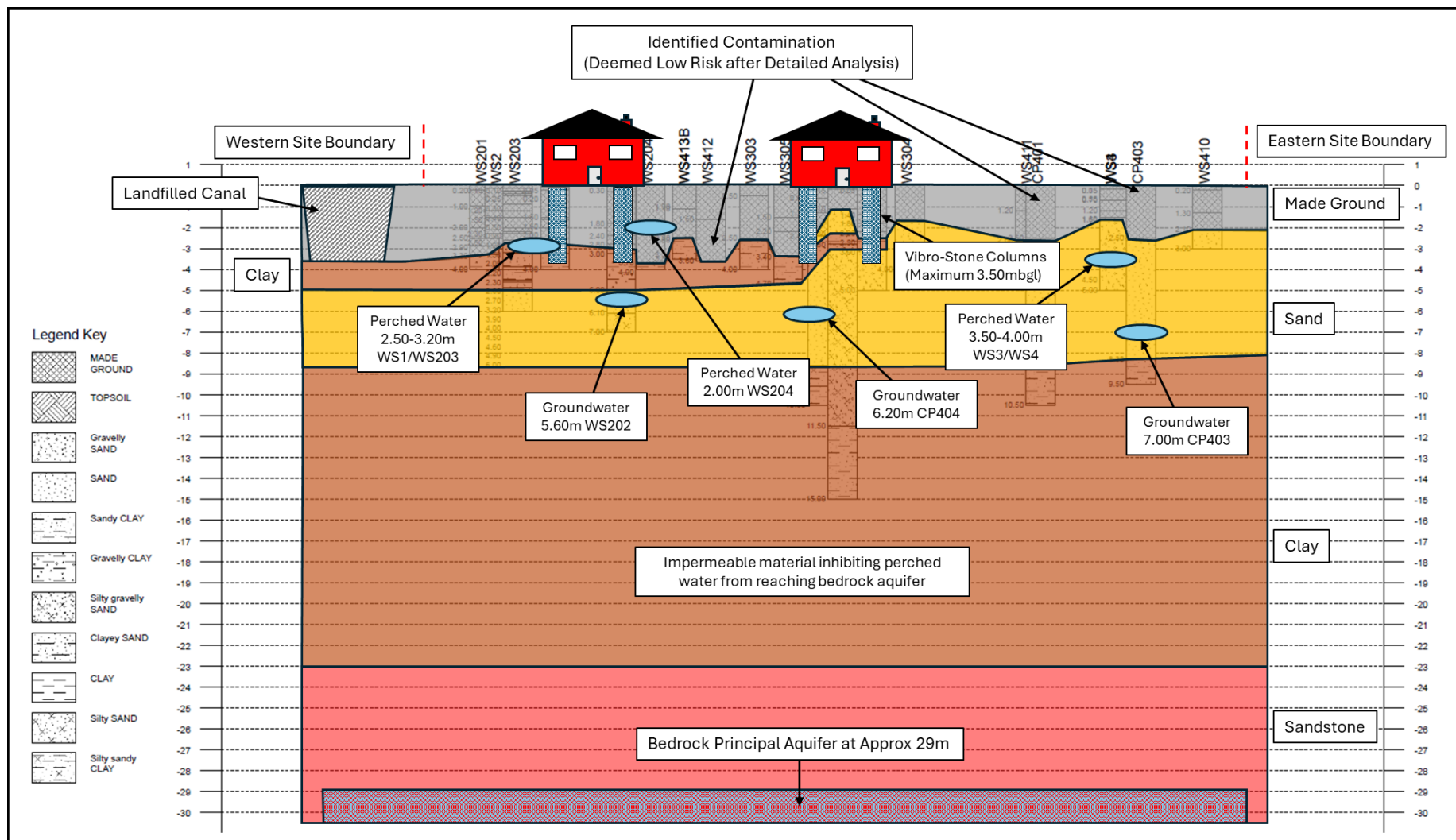
5.0 CONCEPTUAL SITE MODEL

The environmental setting of the site is detailed previously and summarised in a Conceptual Site Model (Figure 12). The salient points were:

- (i) Sandstone rockhead greater than 15.00m beneath the site and locally at 23.60m;
- (ii) Superficial deposits consist of Boulder Clay with a sequence of sand and clay;
- (iii) Groundwater table within superficial sand horizon with shallowest encounter at 5.60m;
- (iv) No groundwater abstraction points within 2km of the site;
- (v) Site is not located within a drinking water safeguarding zone;
- (vi) Landfill site adjacent to western site boundary;
- (vii) No significant contamination identified in soil or groundwater samples in material remaining on site.

A conceptual site model is included overleaf as Figure 12.

Figure 12: Conceptual Site Model



APPENDIX 1

SI OVERLAY PLAN

APPENDIX 2

REPORT LIMITATIONS

REPORT LIMITATIONS

This contract was completed by Earth Environmental & Geotechnical Ltd on the basis of a defined programme and scope of works and terms and conditions agreed with the client. This report was compiled with all reasonable skill, and care, bearing in mind the project objectives, the agreed scope of works, the prevailing site conditions, the budget, and staff resources allocated to the project.

Other than that, expressly contained in the above paragraph, Earth Environmental & Geotechnical Ltd provides no other representation or warranty whether express or implied, is made in relation to the services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of Earth Environmental & Geotechnical Ltd.

If a third party relies on this report, it does so wholly at its own and sole risk and Earth Environmental & Geotechnical Ltd disclaims any liability to such parties.

It is Earth Environmental & Geotechnical Ltd understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was an important factor in determining the scope and level of the services. Should the purpose for which the report is used, or the proposed use of the site change, this report will no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without Earth Environmental & Geotechnical Ltd review and advice shall be at the client's sole and own risk.

The report was written in 2024 and should be read in light of any subsequent changes in legislation, statutory requirements, and industry best practices. Ground conditions can also change over time and further investigations, or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of Earth Environmental & Geotechnical Ltd. In the absence of such written advice of Earth Environmental & Geotechnical Ltd, reliance on the report in the future shall be at the client's own and sole risk. Should Earth Environmental & Geotechnical Ltd be requested to review the report in the future, Earth Environmental & Geotechnical Ltd shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between Earth Environmental & Geotechnical Ltd and the client.

The observations and conclusions described in this report are based solely upon the services that were provided pursuant to the agreement between the client and Earth Environmental & Geotechnical Ltd. Earth Environmental & Geotechnical Ltd has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report.

Earth Environmental & Geotechnical Ltd is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, Earth Environmental & Geotechnical Ltd did not seek to evaluate the presence on or off the site of electromagnetic fields, lead paint, radon gas or other radioactive materials.

The services are based upon Earth Environmental & Geotechnical Ltd observations of existing physical conditions at the site gained from a walkover survey of the site together with Earth Environmental & Geotechnical Ltd interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst Earth Environmental & Geotechnical Ltd have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified.

No responsibility can be accepted for errors within third party items presented in this report. Further Earth Environmental & Geotechnical Ltd was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the services. Earth Environmental & Geotechnical Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to Earth Environmental & Geotechnical Ltd and including the doing of any independent investigation of the information provided to Earth Environmental & Geotechnical Ltd save as otherwise provided in the terms of the contract between the client and Earth Environmental & Geotechnical Ltd.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this report. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Earth Environmental & Geotechnical Ltd] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site.



Depot



KEY



EXTENT OF BASEMENT /
ARCHAEOLOGICAL DIG



ORIGINAL SI - JUNE 2022
TRIAL PIT



ORIGINAL SI - JUNE 2022
WINDOW SAMPLE



ORIGINAL SI - JUNE 2022
WINDOW SAMPLE



SEPTEMBER 23 SI
WINDOW SAMPLE



FEBRUARY 24 SI
WINDOW SAMPLE



BUILDINGS ON SITE
IN JUNE 2022



SAMPLING UNDERTAKEN
SEPTEMBER 23
ASSOCIATED WITH TANK/
HOTSPOT REMOVAL



SOAKAWAY TESTING
- MAY 23



SEPTEMBER 2024 SI
WS & CP BOREHOLES



Rev. Date By Description



Project: LOUISA STREET OPENSHAW			
Drawing Title: SI OVERLAY PLAN SHOWING SAMPLING POINTS FROM TANK REMOVAL & HOTSPOT DELINEATION			
Drawn: PS	Checked:	Scale: 1:500 @ A3	Date: AUG 24
Job No: 1020	Drawing No: ENG302		Rev: -